System Stress Test Assessment

Atlas Design Panel 1

Checkout and Launch Control System (CLCS)

84K00303-027

Approval:

Chief, System Engineering and Integration Division	Date		Date
	Date		Date
	Date		Date

Prepared By:

Emilio Valencia — Date
Thread Lead

NOTE: See "**Supporting Document Note**" on following page

REVISION HISTORY

REV	DESCRIPTION	DATE
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Supporting Document Note:

Acronyms and definitions of many common CLCS terms may be found in the following documents: CLCS Acronyms 84K00240 and CLCS Project Glossary 84K00250.

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Assessment Team

Name	CI Represented	Phone
Achee, Caroline	SGOS Models	1-7727
Blackledge, Jack	Command and Control	1-9078
Boyd, Chris	System Test	1-7365
Edstrom, Roger	Validation TCID	1-7357
Estes, Scott	SIM rehost	1-2403
Francis, Lennox	SGOS Model	1-7573
Gobiara, Janet	Networks	17678
Godfrey, Nancy	Data Fusion	
Goodmark, Steve	Networks	1-2212
Griffin, Laurie	Data Bank	1-2295
Heath, Jeff	EIM Services	1-9057
Hrezo, Gary	System Viewers	1-9002
Jameison, Tom	System Engineering	1-9088
Kerschner, Barbara	User Applications	1-7532
King, Charla	Test, Build and Control	1-7587
Lee, Gary	User Applications	1-7558
Lee, Jeff	System Engineering	1-9073
Lee,Roger	Test Data Generator	1-7697
Leondike, Jim	Application Services	1-9022
Merrill, William	User Apps (Fusion Algorithm)	1-2232
Reinhardt, Dave	System Test	1-7362
Ross, Terry	Performance Modeling	1-9066
Trawick, Jim	EIM Services	1-9042
Valencia, Emilio	SE Thread Lead	1-9074
Wix, Tom	User Applications	1-2267

The matrix above is used to identify the members of the assessment team. The Assessment Team Lead (ATL) fills this out with the members of the assessment team.

1. INTRODUCTION

1.1 System Stress Test Thread Overview

The System Stress Test (SST) will be used to determine where the system "breakage" occurs and what the system performance margins are. A baseline of the SST will be established and will be used to compare the results when a SST is performed using new software and/or hardware. The intent is to keep the SST as stable as possible between releases so valid comparisons can be made. Once the comparison is made and verified, any modifications or improvements can be incorporated into the SST.

The development of the System Stress Test and its tools will be an on-going process throughout most of the CLCS deliveries. As CLCS matures and more is known about the system, a better SST can be developed to capture the limits of the system. Improvements and/or modifications to the SST tools will be available following the formal SST. As a minimum, the SST will be performed after each System Test is complete
This thread will evaluate if the CLCS architecture will be able to support system load conditions. This thread will build on the Thor work.

This thread consists of the following main items:

- Use Models as data source
- Utilize Regression Test Tool to control stress test (TBD)
- Expand Validation TCID if necessary
- Expand/enhance test tool capabilities developed for Thor
- Maximize automation for test control

Highlights:

- Demonstration of the system under several load conditions.
- Support Performance requirement Buy Off

1.2 System Stress Test Thread Concept

The focus of this thread is to continue the development and/or enhancement of the stress test tools and to obtain a performance baseline for the system using the Atlas Release software. This performance baseline will be used to compare the resultant performance baseline of the Titan release to determine what performance improvement or degradation has occurred with the new updated system. An updated system is defined as a change in the software and/or hardware. The performance baseline will be reestablished whenever the system is updated.

In order to make valid comparisons between the current performance baseline and the new performance baseline, the TCID used by the SST will be the validation TCID. It will require the following FDs to be defined:

- At least one FD for each data type
- Data Fusion FDs unique to the SST
- EIM FDs unique to the SST
- Command FDs

The SST allows baseline numbers to be determined for different processing areas of the system. The different processing areas or as it will now be called the SST components have been identified and are show in Figure 1. The components can be executed in one of two modes. Executing a component while the system is processing data at a default change data rate allows a system "performance margin number" to be determined. Executing a component while the system is not processing data allows a system "maximum performance number" to be determined. Most of the components can be executed in either mode. Each component will have the capability to "ramp-up" the load automatically to allow the system "break point" to be easily determined.

The SST is made up of six components. The components are as follows:

- System Data Rate
- Processor Data Rate
- Network
- EIM
- Display
- Data Fusion

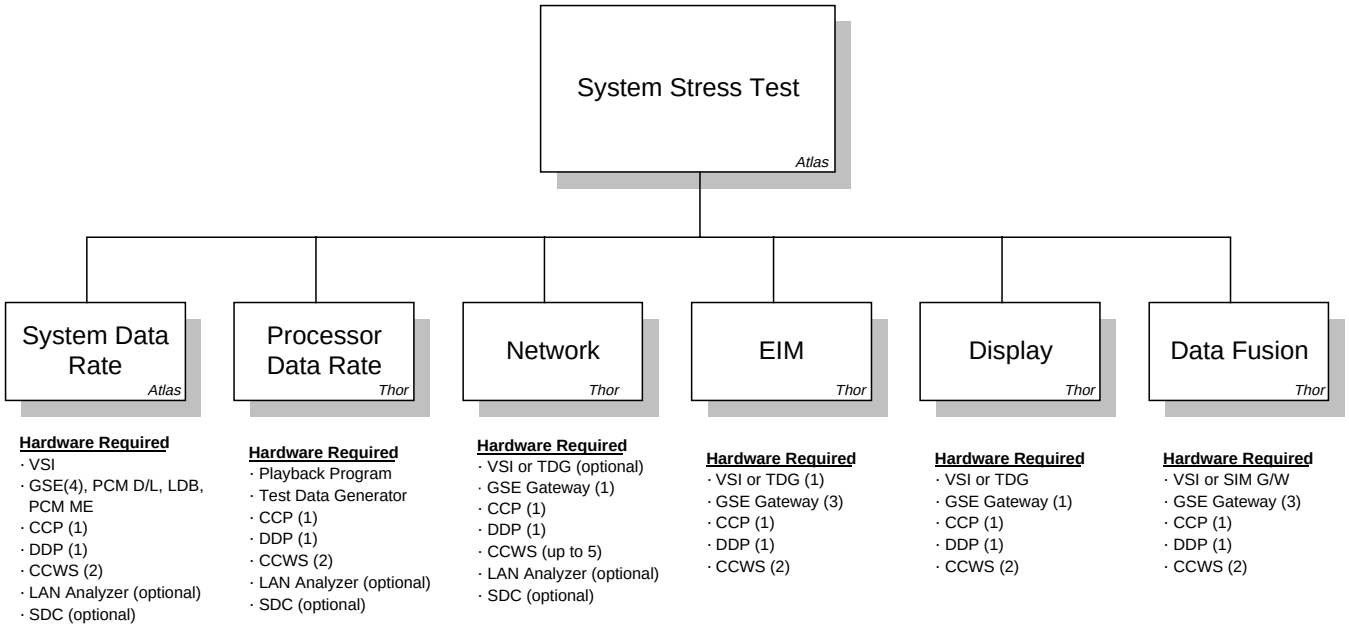

Figure 1 - System Stress Test Components

1.3 Operational and Functional Overview

The SST will be performed after every System Test is complete. Initially, a 2 week period will be allocated to perform the test but as the system matures and the SST becomes more automated, the time required to perform the SST will diminish drastically. The different test areas, as described in the previous section, will be performed sequentially and will not be combined. Although, the possibility of running 2 or more test areas concurrently is not precluded. As part of the build up of the SST, test tools will be developed specifically for SST and will be verified.

1.3.1 System Default Configuration

The System Default Configuration provides a running base of operational processes and allows the SST component to be layered on top to determine the system's "performance margin". The System Default Configuration will define the initial condition of the system before a particular component is executed. A System Default Configuration is required for the EIM, Display and Data Fusion components. It is optional for the Network component. The configuration will specify the required change data rate, hardware and processes. This configuration will be specified in the SST Plan and Procedures Document (84K07003-005).

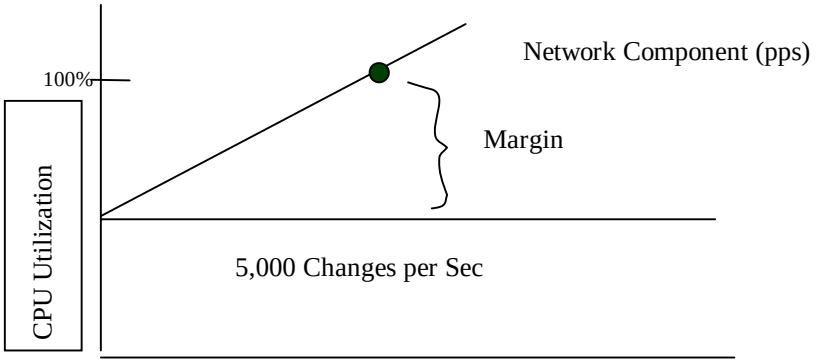

Figure 2 – Network Test with Default Configuration

COMPONENT	SYSTEM DEFAULT CONFIGURATION	Processors Required
System Data Rate	Not required	G/W, CCP, DDP, CCWS
Processor Data Rate	Not required	TDG, CCP, DDP, CCWS
Network	Optional	CCP, DDP, CCWS
EIM	Required	TDG, G/W, CCP, DDP, CCWS
Display	Required	TDG, CCP, DDP, CCWS
Data Fusion	Required	TDG, CCP, DDP, CCWS

Table 1 – System Default Configuration Requirements

1.3.2 System Data Rate Test

In the System Data Rate component, data is sent from the Model to the RTPS gateways to determine the maximum change data rate that can be processed by the RTPS. Processing in the RTPS is limited to the handling of data only. No data fusion or constraint processing will be performed and very limited EIM processing will occur. As an option, the SDC can be included in this component after the RTPS maximum rate has been determined.

The tools required for this component are the Model and the performance measurement scripts. Optionally, a LAN Manager/probe can be connected to provide a more detailed analysis of the network traffic. LAN Manager software will be developed to gather statistics on RTPS unique data packets.

1.3.3 Processor Data Rate Test

In the Processor Data Rate component, data is sent from the Test Data Generator (TDG) to the DDP to determine the maximum change data rate that can be processed by the CCP and DDP. RTPS gateways are not included as part of this component. Processing in the RTPS is limited to the handling of data only. No data fusion or constraint processing will be performed and very limited EIM processing will occur. As an option, the SDC can be included in this component after the maximum rate has been determined for the CCP/DDP.

The tools required for this component are the Playback PC (used to send data to the TDG), the TDG and the performance measurement scripts. Optionally, a LAN Manager/probe can be connected to provide a more detailed

analysis of the network traffic. LAN Manager software will be developed to gather statistics on RTPS unique data packets.

1.3.4 Network Test

The Network component determines the maximum amount of network traffic that can be handled by a processor. A software test tool unique to this component provides the capability to send and receive data streams over the network utilizing RM services. The tool can be executed on any of the processors (CCP, DDP, CCWS) and can test either the DCN or RTCN networks. The tool has the capability to increase the network traffic automatically. As the network traffic increases, the affect on the processor load can be determined. This component provides testing up through and including the Session Layer of the OSI Model.

In addition to the software test tool, an analysis tool is being developed to monitor data on the networks (RTCN & DCN) at the RTPS packet level. MIB tables and scripting will be developed that allow RTPS packet statistics to be collected.

The tools required for this component are the Network Test Tool (NTT), and the performance measurement scripts. Optionally, LAN analyzers/probes can be connected to monitor network traffic.

1.3.5 EIM Test

The EIM component determines the maximum EIM processing the system can handle before reaching the "breakpoint". Different types of "EIM processing" will be tested for maximum rates. The different types of "EIM processing" include reading FD values, sending system messages, sending commands, etc. (refer to Section 1.3.1 for a complete list of types). Unique SST EIM applications provide the capability to increase EIM processing in different areas and allow the "breakpoints" to be determined. The SST EIM applications also provide the test with a stable set of applications to allow valid comparisons to be made between system updates. The test procedures will specify which EIM applications are concurrently executing and which ones execute as standalone. Actual system EIM applications or portions of an application used in the operational system may be folded into the test at a later date when the EIMs become more stable, if desired

The tools required for this component include a data source (Model or TDG), SST EIM applications, gateway test mode **(TBD)** and the performance measurement scripts.

1.3.6 Display Test

The Display component determines the maximum number of displays that can be active on a CCWS simultaneously. It can also be used to determine the "processor margin" while running a CLCS display. Different types of displays will be tested which include continuously reading digital pattern FD values, continuously reading analog FD values, and a graphically intensive display. The test procedures will specify which displays are concurrently executing simultaneously.

The tools required for this component include a data source (Model or TDG), SST displays, CLCS display (optional) and the performance measurement scripts.

1.3.7 Data Fusion Test

The Data Fusion component determines the maximum Data Fusion processing the system can handle before reaching the "breakpoint". Data Fusion algorithms developed specifically for the SST will be used to test the system. These algorithms will provide the test with a stable set of algorithms that allows the test to measure the margin consistently from one SST to another. Data fusion algorithms used in the operational system can be folded into the test at a later date if desired. The algorithms designed specifically for the SST include peak detection, time averaging, comparisons,

etc. The test procedures will specify which algorithms are executing concurrently. The data source provides the increase in change data rate for the FDs affecting the data fusion algorithms.

The tools required for this component include a data source (Model or TDG), SST Data Fusion Algorithms, gateway test mode **(TBD)** and the performance measurement scripts.

1.4 System Stress Test Thread Specification

1.4.1 Statement of Work

- Perform Atlas developed Stress Test with Atlas Baseline.
- Simulate using real Gateways, 4 Ground Support Equipment busses, 1 PCM Down Link, 1 Space Shuttle Main Engine links and 1 Launch Data Bus running at rates up to all data changing.
- Utilize a test TCID with:
  - 100 to 200 test FDs
  - Data for 1 format of OI downlink FDs
  - Data for 1 format of GPC downlist FDs
  - Shuttle Main Engine FDs
  - Selective Launch data Bus Command FDs
- Provide a group of simple Data Fusion functions for 100 of the test FDs
- Provide a set of SGOS models to drive test FDs.
- Provide a group of test End Item Managers to support system testing
- Perform testing of Recording Interface.
- Build two End Item Managers that respond to Ground Support Equipment inputs.
  - Schedule with Constrain Notification and/or timer.
  - When input Discrete changes output a command to set Discrete output
  - When input Discrete changes output a command to look for input to change back.
  - Increment a counter.
  - Cross connect output from one End Item Manger to input of the other.
- Build an End Item manager to create and execute pthreads
- Perform testing of Gateway performance.
- Provide performance data for system modeling.
- Provide a mechanism to increase load beyond the performance requirements.

1.4.2 Requirements

NOTE: The requirements shown here are for reference only and are not the requirements levied against the test tools developed for this thread.

(SLS-2.2.2.1.1) The system shall support 25,000 End-Item Function Designator changes per second continuously. This is the "system maximum data bandwidth".

(SLS-2.2.2.1.2) The system shall support a peak of 50,000 End-Item Function Designator changes in a given second without losing any data.

Rationale: The system will need to have a flow control mechanism to support buffering instead of losing data when peak change rates occur. This system is being used to consolidate several systems. Some of these systems and their rates are TBD. Therefore the above requirements are written with expansion in mind. We do not want to say the system will support all changes on all links.

(SLS-2.2.2.1.3) The system shall support 1,000 End-Item Function Designator changes during a 10 millisecond period.

(SLS-2.2.2.1.15) The Data Health Function shall support the "system maximum data bandwidth".

(SLS-2.2.2.1.16) The Data Fusion function shall support the "system maximum data bandwidth" with one fusion calculation per change.

Rationale: Although our goal is to execute the fusion algorithms within one System Synchronous Rate Time Period no time limit requirement is included. During peak data rate times the algorithm must support a lag in Fusion calculations. However, to assure that time critical functions are executed in a timely fashion, Data Fusion will provide a priority mechanism (ref. Section 2.2.5 - System Support for User Applications/Data Fusion.).

(SLS-2.2.2.1.17) The Constraint Function's data limit function shall support three constraint checks per measurement FD while supporting the "system maximum data bandwidth", including Fusion FDs.

(SLS-2.2.2.1.18) The Constraint Manager notification function shall be capable of providing 100 notifications per second while supporting the "system maximum data bandwidth".

(SLS-2.2.2.1.19) The data distribution function shall support the "system maximum data bandwidth", plus 5,000 (20%) Data Fusion updates per second.

(SLS-2.2.2.1.21) The system shall support (while executing at 40 percent of the system maximum data bandwidth) 25 Constraint Management requests from each of 4 Command and Control Processor Subsystems (100 Total), 20 constraint event notifications (5 per CCP), and 4 commands (1 per CCP) with each CCP executing 20 User Test Applications which are executing 500 Application Service calls per second.

(SLS-2.2.2.2.1) The Display function shall, for a single workstation, support updating 50% of the FD's every second on 13 windows with 100 FD's in each window.

(SLS-2.2.2.2.2) RTPS shall be able to support full Uplink command rates on the following links:

- LDB - 8/second
- *PCM Uplink - 16.67/second or 50/second*
- GSE - 500/second.

(SLS-2.2.2.2.6) The Display function shall, for a single workstation, support updating of 250 displayed FDs out of 500 in one second.

(SLS-2.2.2.2.7) The Display function shall, for a single workstation, support updating 50% of the FD's every second on 13 windows with 100 FD's in each window.

(SLS-2.2.2.2.11) Each CCP shall support 5 End-Item System test applications, with 6 test applications for each System (30 Processes) with each test application executing 500 Application Service calls per second (15,000 calls/second) while executing at 5 percent of the system maximum data bandwidth (TBD). The ratio of application service calls are 45 local application services (read, if, compare, etc.), 4 constraint management notification changes and 1 command for every 50 calls. The test applications are to be the same priority level and each is allowed to execute at least 10 times per second.

1.5 System Stress Test Thread Hardware Diagram

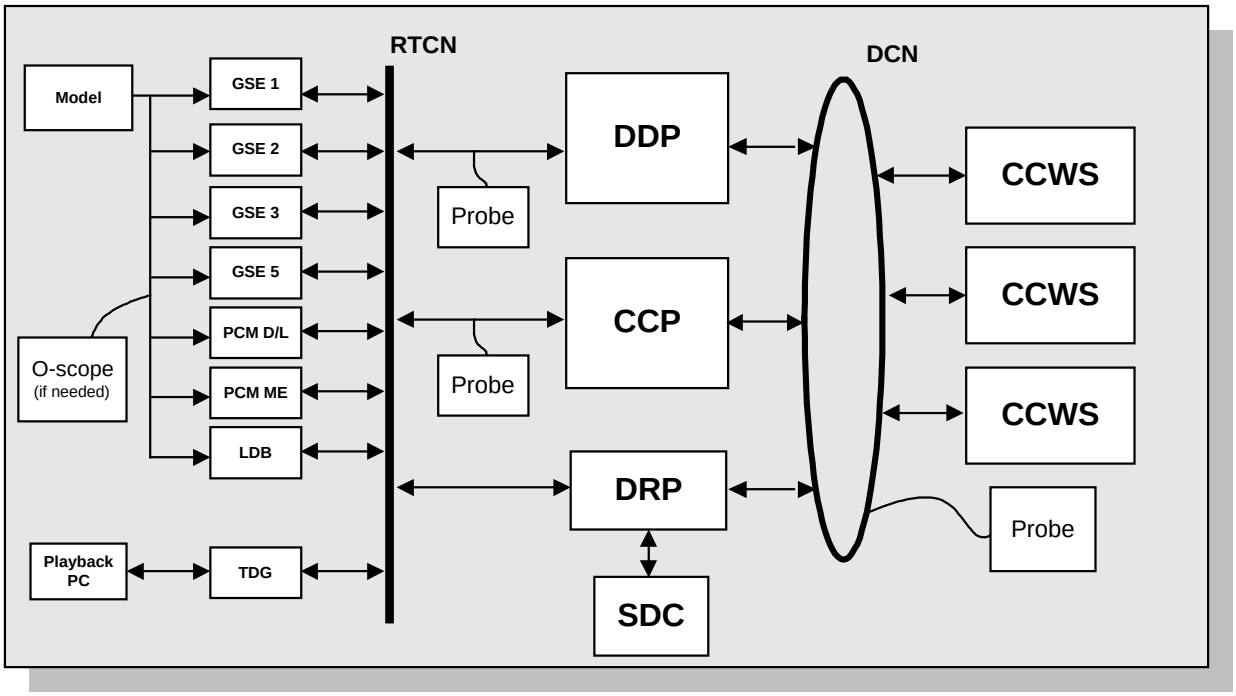

Figure 3 - System Stress Test Atlas Configuration

1.6 System Stress Test Thread Deliverables

Software:

Deliverable	R&D	Code	API Manual	Users Guide
Model(s)	Yes	Yes		Yes
Network Test Tools	Yes	Yes		Yes
Stress Test EIMs	Yes	Yes		Yes
SL Displays	Yes	Yes		Yes
Data Fusion Algorithms	Yes	Yes		Yes

Documents:

Deliverable	Document
System Stress Test Plan and Procedures	X
System Stress Test Report	X

1.7 System Stress Test Thread Assessment Summary

1.7.1 Labor Assessments

The total Labor Costs required to provide this capability are summarized in the following table;

No.	CSCI/HWCI Name	Atlas LM	Changes covered in
1	RTPS Test Suite CSCI - Stress/Performance Test Suite	12.5	
2	Common Gateway Services **(TBD)**	0.5	
3	Test, Build & Control	0.0	Test Build & Load Thread
4	Performance Modeling Test Support	1.0	
5	Data Distribution and Processing Test Support	1.0	
6	Development of System Stress Test	1.0	
7	Update System Stress Test Plan & Procedures	1.0	
8	Perform System Stress Test	2.0	
9	Generate System Stress Test Report	0.5	
	TOTAL	19.5 LM	

1.7.2 Hardware Costs

Any hardware (network) analysis tools are assumed to be available.

1.7.3 System Stress Test Thread Procurement

None

1.8 System Stress Test Thread Schedule & Dependencies

1.8.1 Schedule

Task Name	**Start**	**Finish**
Concept Panel Internal Review #1		03/17/98
Concept Panel Internal Review #2		06/02/98
Concept Panel		06/04/98
Atlas Development		
Requirement Panel		
Design Panel		
Test Tools Complete (EIM, Network, Display, etc)		11/20/98
Models Complete		11/20/98
Test Plan & Procedures		12/18/98
Perform Stress Test		01/99
Test Report complete	2 weeks after stress test completed	

1.8.2 Dependencies

No.	Dependency Area	Dependency	Need Date
1	Networks	Network analysis tools (COTS)	01/99

No.	Dependency Area	Dependency	Need Date
2	Gateway	Test Data generator (TDG)	01/99
3	Gateway	PCM D/L, ME, LDB, & GSE Gateways	01/99
4	Operations	Model	01/99

1.9 System Stress Test Thread Simulation Requirements

None

1.10 System Stress Test Thread Integration and System Test Plan

The stress test will be performed on a system configured with the Atlas Release Software. The TCID used will be the Validation TCID and the SCID used will include System Stress Test unique test tool products. Although, the test tools developed specifically for the SST will be tested and verified, the test tool requirements themselves will not be formally verified. Where applicable, hardware analyzers and/or proven diagnostic tools will be used to verify the SST tools.

The Stimuli includes:

- Models used as the data source
- Network test tool used to generate traffic on DCN or RTCN
- Model used to respond to issue commands
- EIMs used to initiate/stimulate system processes

The analysis includes:

- using COTS performance monitoring tools to analyze system parameters (measure CPU, memory & I/O utilization)
- using vendor supplied performance monitoring utilities
- using a LAN analyzer and/or manager to measure network data rates and collect statistics
- viewing System messages for verification purposes

The system test plan should include procedures to increase or decrease the following loads on an individual basis:

- RTCN traffic (change data)
- DCN traffic
- Command rate
- EIM processes
- Dynamic display processes

System Stress Test Plan and Procedures will be prepared by the System Test Organization

This test will be performed immediately following the Atlas Release System Test efforts.

1.11 System Stress Test Thread Training Requirements

None

1.12 System Stress Test Thread Facilities Requirements

None

1.13 Travel Requirements

None

1.14 System Stress Test Thread Action Items/Resolution

None

2. CSCI ASSESSMENTS

This section is provided for the individual CSCI leads to fill in and provide the details of their assessments. The thread lead should use this information to provide the summaries in section 1. The details of this and subsequent sections are not presented in any of the panels unless needed by the presenter as backup.

2.1 RTPS Test Suite CSCI Assessment

Stress Test Displays Work Required

Modify the SL-GMS driver to allow multiple copies of the same display to run simultaneously. Provide approximately 5 new displays (low complexity).

Network Test Tools Work Required

Develop Stress Test unique MIB tables and scripting required to collect statistics on RTPS packets. Implement management station.

Stress Test EIMs Work Required

It is anticipated that 5 or 6 new EIMs will be developed. Two of these EIMs will respond to GSE inputs and one will deal with asserting constraints. Also, enhancements to EIMs developed during Thor will be provided.

Stress Test Data Fusion Algorithms Work Required

There are no changes necessary to DDP.

- **Data Distribution CSC Work Required**

  Provide debug analysis and support during the stress test.

- **Data Fusion CSC Work Required**

  Provide debug analysis and support during the stress test.
  Provide support to an application developer when producing a Data Fusion Algorithm.

- **Data Health CSC Work Required**

  Provide debug analysis and support during the stress test.

- **Constraint Manager CSC Work Required**

  Provide debug analysis and support during the stress test.

System Viewers Work Required

The System Stress Test Viewer will provide the capability to begin the System Stress test, display feedback on which test is occurring, display a plot from historical system stress data, and using the provided APIs, this viewer will allow the user to filter FDs.

Stress Test Models Work Required

This is a list of work to be accomplished for this function.

CSCI Assessment

CSC Name	CSC Labor (LM)	% of CSC
Stress Test Displays	1.0	
Network Test Tools	2.0	
Stress Test EIMs	3.0	
Stress Test Data Fusion Algorithms	1.5	
Stress Test GUI	4.0	
Stress Test Models	1.0	

Basis of estimate

Provide your basis for estimating the labor to implement this capability. Lines of lines of code is one way to estimate the labor requirements. Your CSCs may be developed in such a way as to make this impractical (e.g., large amount of reuse code or code generated by a tool).

Documentation

Provide your assessment of the kinds and amount of documentation that must be provided with the capability.

Example:

Document Type	New/Update	Number of Pages
Requirements and Design Documentation	New	TBD
Users Guide	New	TBD
API Interface Document		
Interface Design Document	New	TBD
Test Procedure	New	TBD

Assumptions

Provide a list of assumptions you made that are pertinent to the assessment. If there are no assumptions state none.

Open Issues

Provide a list of open issues if there are any. If there are none state none.

2.2 Performance Modeling Support

Work Required

Provide inputs to Stress Test development and development of System Stress Test Procedures. Development of scripts to gather test statistics. Provide support during system Stress Test.

Assessment

Name	Labor (LM)
System Stress Test support	1

3. HWCI ASSESSMENTS

None

4. COTS PRODUCTS DEPENDENCIES

4.1 SW Products Dependency List

None

4.2 HW Products Dependency List

Network analyzer and/or manager assumed available.